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July 2005

AERIAL PHOTOGRAPHIC ANALYSIS
ST. LOUIS (EX) ARSENAL SITE

St. Louis, Missouri

by

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Contract No. 68-D-00-267

Work Assignment Manager

P. A. Arberg
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August 9, 2005

EPA/Environmental Photographic
Interpretation Center
12201 Sunrise Valley Drive
555 National Center
Reston, VA 20192

Attention: P. A. Arberg

Subject: Final Delivery of "Aerial Photographic Analysis of St. Louis (EX) Arsenal Site, St. Louis, Missouri, ESD-LV Project 20507007S"

Dear Mr. Phil Arberg:

Three (3) copies of the above mentioned final hardcopy report and nine (9) sets of CDROMs containing the digital geographic information system (GIS) ArcView product were prepared for this task. Two (2) reports and eight (8) CDRoms were shipped to Ms. Diana Bailey of EPA Region 7 Office as per your instructions. Also included is the Availability & Photography Ordered Form. This completes delivery of all products for work assignment PIC-20507007S. If you have and questions, please contact me at 897-3241.

Very truly yours,

Webster M. Mack
Remote Sensing Support Services
Contract

cc: Larry Tinney
Larry Mata
W.A. RS57007S

NOTICE

This document has undergone a technical and quality control/assurance review and has been approved for publication by personnel of the U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, Landscape Ecology Branch at Las Vegas, Nevada. It is for internal Agency use and distribution only.

ABSTRACT

This report presents the results of a photographic analysis of the St. Louis (EX) Arsenal site in St. Louis, Missouri. A portion of the site located at 3200 South 2nd Street is occupied by the Defense Mapping Agency. The full site is bounded to the northwest by South Broadway, to the southwest by Utah Street, to the southeast by the Mississippi River waterfront, and by Arsenal Street to the northeast. The site covers approximately 16 hectares (40 acres) at an elevation of approximately 130 meter (425 feet) above sea level.

Nine years of historical photographs covering the period from 1937 through 2004 were obtained, eight of which were reproduced for inclusion in this report (1937, 1941, 1950, 1968, 1977, 1982, 1993, and 2004). The purpose of this analysis is to identify training, storage, and waste disposal areas and other observable conditions of environmental significance on this site, and to document potential sources and pathways of groundwater contamination. This report provides operational remote sensing support to U.S. Environmental Protection Agency (EPA) Region 7 for a site assessment under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The analysis results are presented in two formats, this hardcopy report and a separate digital geographic information system (GIS) version that presents these findings using the ArcView GIS software package.

The findings show that the northwest portion of the site was identified as Lyon Park during the period of this analysis and no environmentally significant activity or features were observed in the park. In the central portion of the site, which has historically been operated by the U.S. government and Department of Defense (DOD), no features were identified as ammunition storage areas, explosive powder storage areas, incinerators, burn areas, lagoons/impoundments, training areas, bunker structures, or magazines that might be associated with an arsenal. However, three areas-of-concern (AOC-1

through AOC-3) that include a storage area and locations of mounded material were identified as potential sources of contamination. Within the river barge terminal and pier facility in the southeast portion of the site, four areas-of-concern (AOC-4 through AOC-7) that include a storage tank area, barge loading pier, and a storage area with supplies are noted. These were identified as potential sources of pollution entering the adjacent Mississippi River.

The EPA Landscape Ecology Branch in Las Vegas, Nevada, prepared this report for the EPA Region 7 Superfund Division in Kansas City, Kansas, and the EPA Office of Emergency and Remedial Response in Washington, D.C.

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INTRODUCTION

This report presents the results of a historical aerial photographic analysis of the St. Louis (EX) Arsenal site in St. Louis, Missouri (CERCLIS ID# MON000704875). The full site covers approximately 16 hectares (40 acres) at an elevation of approximately 130 meter (425 feet) above sea level (Figures 1 and 2). The purpose of this analysis is to identify training areas, storage, and waste disposal areas and other observable conditions of environmental significance on this site and to document potential sources and pathways of groundwater contamination. The analysis used aerial photographs spanning the period from 1937 through 2004. Eight selected dates of photo coverage (1937, 1941, 1950, 1968, 1977, 1982, 1993, and 2004) are included in this report. This report provides operational remote sensing support to U.S. Environmental Protection Agency (EPA) Region 7 for a site assessment under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The analysis results are presented in two formats, this hardcopy report and a separate digital geographic information system (GIS) version that presents these findings using the ArcView GIS software package.

The St. Louis (EX) Arsenal site is bounded to the northwest by South Broadway, Utah Street to the southwest, the Mississippi River waterfront to the southeast, and Arsenal Street to the northeast. During the entire period of this analysis the site is transected by South 2nd Street and a railroad corridor; Lyon Park occupied the northwest portion of the site, the wall-enclosed Defense Mapping Agency facility occupied the central portion of the site, and a river terminal and pier facility were observed in the southeast portion of the site.

A primary collateral information source used in this analysis is the TechLaw site inspection review report which identified 35 specific buildings within the central portion of the site occupied by the Defense Mapping Agency facility (TechLaw, 2004). The same building number designations used in the

TechLaw report have been incorporated into this report. Additional buildings, features, and areas-of-concern identified through this analysis are annotated with letter designations unique to this report.

The following background information was provided by EPA (EPA, 2004). The U.S. government acquired the site in 1827, at that time the site consisted of both timber and cultivated land. The St. Louis Arsenal (SLA) was established in 1827 and eventually contained 22 buildings within a stone wall enclosure. The arsenal supported the U.S. Cavalry until 1886. The site was used by the U.S. Army as a clothing and general supply depot until 1927. The SLA was redesigned and was called the St. Louis Medical Depot from 1927 until 1952 when it was transferred to the U.S. Air Force (USAF). The USAF Scott Air Force Base, the host command for the site, has used the mapping facility throughout various missions, name changes, and mergers including the Aeronautical Chart and Information Center, Defense Mapping Agency Aerospace Center, National Imaging and Mapping Agency, and the National Geospacial-Intelligence Agency.

The findings of this report show that the northwest portion of the site was identified as Lyon Park during the entire duration of this analysis and no environmentally significant activity or features were observed in the park. In the central portion of the site, which has historically been operated by the U.S. government and Department of Defense (DOD), no features were identified as ammunition storage areas, explosive powder storage areas, incinerators, burn areas, lagoons/impoundments, training areas, bunker structures, or magazines that might be associated with an arsenal. However, three areas-of-concern (AOC-1 through AOC-3) that include a storage area and locations of mounded material were identified as potential sources of contamination. Within the river barge terminal and pier facility in the southeast portion of the site four areas-of-concern (AOC-4 through AOC-7) were noted and include a storage tank area, barge loading pier, and a storage area with supplies. These areas-of-concern were identified as potential sources of pollution entering the adjacent Mississippi River.

A Glossary, defining features or conditions identified in this report, follows the Photographic Analysis section. Sources for all maps, aerial photographs, and collateral data used in the production of this report are

listed in the References section. A list of all aerial photographs that were identified and evaluated for potential application to this study can be obtained by contacting the EPA Work Assignment Manager. Historical aerial photographs used in the analysis of this site have been digitally scanned and printed for use in this report. A transparent overlay with interpretative data is affixed to each of the digital prints. See the Methodology section for a discussion of the scanning and printing procedures.

The EPA Landscape Ecology Branch in Las Vegas, Nevada, prepared this report for the EPA Region 7 Superfund Division in Kansas City, Kansas, and the EPA Office of Emergency and Remedial Response in Washington, D.C.

Figure 1. Study area location map, Missouri (USGS, 1972). Approximate scale 1:2,500,000.

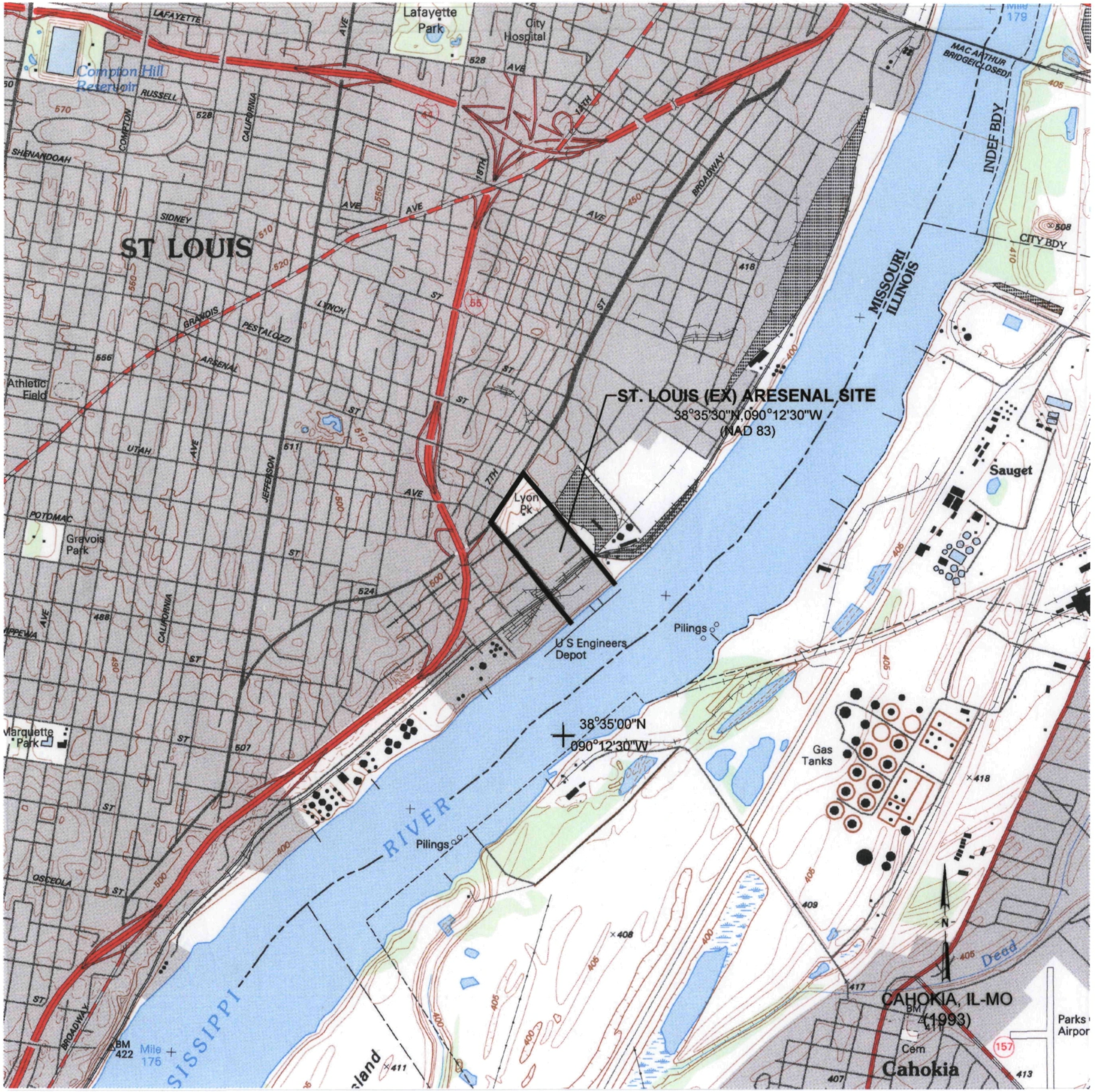

Figure 2. Local study area location map, Cahokia, IL-MO (USGS, 1993). Approximate scale 1:24,000.

METHODOLOGY

This report was prepared using a standard methodology that includes the following steps:

- data identification and acquisition,
- photographic analysis and interpretation, and
- graphics and text preparation.

These steps are described below. Subsections also address details related to specific kinds of analyses that may be required to identify environmental features such as surface drainage and wetlands. All operational steps and processes used to perform this work (including data identification and acquisition, photographic analysis and interpretation, and graphics and text preparation) adhere to strict QA/QC guidelines and standard operating procedures (SOPs). These guidelines and procedures are documented in the Master Quality Assurance Project Plan (QAPP) prepared for Remote Sensing Support Services Contract No. 68-D-00-267 (LMS, 2004).

Data identification and acquisition included a search of government and commercial sources of historical aerial film for the study area. Photographs with optimal spatial and temporal resolution and image quality were identified for acquisition. In addition, U.S. Geological Survey (USGS) topographic maps were obtained to show the study area location and to provide geographic and topographic context.

To conduct this analysis, the analyst examined diapositives (transparencies) of historical aerial photographs showing the study area. Diapositives are most often used for analysis instead of prints because the diapositives have superior photographic resolution. They show minute details of significant environmental features that may not be discernible on a paper print.

A photographic analyst uses a stereoscope to view adjacent, overlapping pairs of diapositives on a backlit light table. In most cases, the stereoscope is capable of various magnifications up to 60 power. Stereoscopic viewing involves using the principle of parallax (observing a feature from slightly different positions) to observe a three-dimensional representation of the area of interest. The stereoscope enhances the photo interpretation process by allowing the analyst to observe vertical as well as horizontal spatial relationships of natural and cultural features.

The process of photographic analysis involves the visual examination and comparison of many components of the photographic image. These components include shadow, tone, color, texture, shape, size, pattern, and landscape context of individual elements of a photograph. The photo analyst identifies objects, features, and "signatures" associated with specific environmental conditions or events. The term "signature" refers to a combination of components or characteristics that indicate a specific object, condition, or pattern of environmental significance. The academic and professional training, photo interpretation experience gained through repetitive observations of similar features or activities, and deductive logic of the analyst as well as background information from collateral sources (e.g., site maps, geologic reports, soil surveys) are critical factors employed in the photographic analysis.

The analyst records the results of the analysis by using a standard set of annotations and terminology to identify objects and features observed on the diapositives. Significant findings are annotated on overlays attached to the photographic or computer-reproduced prints in the report and discussed in the accompanying text. Annotations that are self-explanatory may not be discussed in the text. The annotations are defined in the legend that accompanies each print and in the text when first used.

Objects and features are identified in the graphics and text according to the analyst's degree of confidence in the evidence. A distinction is made between certain, probable, and possible identifications. When the analyst believes the identification is unmistakable (certain), no qualifier is used. Probable is used when a limited number of discernible characteristics allow the

analyst to be reasonably sure of a particular identification. Possible is used when only a few characteristics are discernible, and the analyst can only infer an identification.

The prints in this report have been reproduced, either by photographic or computer methods, from the original film. Reproductions are made from the original film and may be either contact (the same size) prints or enlargements, depending on the scale of the original film. Any computer-produced prints used in this report are generated from scans of the film at approximately 1,300 dots per inch (dpi) and printed at 720 dpi. Although the reproductions allow effective display of the interpretive annotations, they may have less photographic resolution than the original film. Therefore, some of the objects and features identified in the original image and described in the text may not be as clearly discernible on the prints in this report.

Study area boundaries shown in this report were determined from aerial photographs or collateral data and do not necessarily denote legal property lines or ownership.

Digital Diapositives

Some film vendors no longer supply analog film products (e.g., diapositive transparencies) to their customers. Digital files, created by scanning the original analog film products, are provided. The digital file, a representation of an original analog film product, can be analyzed either by computer viewing techniques or by creating a secondary diapositive from the digital file and viewing the secondary diapositve on a light table. The result of this process of converting an analog diapositive image to a digital file may be a reduction in the photographic resolution. A potential consequence of this in the realm of aerial photographic analysis is a lower confidence in the identification of features or conditions of environmental significance. For example, what may have been identified with certainty as "a drum" on the analog version of the diapositive may, on the digital diapositive, only be determined to be "a probable drum."

Surface Drainage

The surface drainage analysis produced for this report identifies the direction and potential path that a liquid spill or surface runoff would follow based on the topography of the terrain and the presence of discernible obstacles to surface flow. The analyst determines the direction of surface drainage by stereoscopic analysis of the aerial photographs and by examining USGS topographic maps. Site-specific surface drainage patterns are annotated on the map or photo overlay. Where the direction of subtle drainage cannot be determined, an indeterminate drainage line symbol is used. Regional surface flow is ascertained from the USGS topographic maps.

PHOTOGRAPHIC ANALYSIS

During the entire time period covered in this analysis the St. Louis (EX) Arsenal site has been transected by South 2nd Street and a railroad corridor; Lyon Park occupied the portion of the site north of South 2nd Street, the wall-enclosed Defense Mapping Agency facility occupied the portion of the site between South 2nd Street and the railroad corridor, and a river terminal occupied the portion of the site south of the railroad corridor.

Potential contamination sources were identified within the Defense Mapping Agency facility and noted as three areas-of-concern (AOC-1 through AOC-3). These areas-of-concern included a storage area and locations of dark-toned mounded material. Potential threats to surface runoff were identified within the river terminal at four areas-of-concern (AOC-4 through AOC-7) that consisted of an area of vertical and horizontal storage tanks, a barge loading pier, and storage areas with supplies and/or debris. These areas-of-concern were identified as potential sources of spillage or leakage that could threaten the adjacent Mississippi River.

Table 1 portrays the historical observations by date for each building, feature and area-of-concern tracked over time in this analysis.

Table 1. St. Louis (EX) Arsenal feature observations by photographic date.

IDENTIFIER	FEATURE	1937 OBSERVATIONS	1941 OBSERVATIONS	1950 OBSERVATIONS	1968 OBSERVATIONS	1977 OBSERVATIONS	1982 OBSERVATIONS	1993 OBSERVATIONS	2004 OBSERVATIONS
1	Dining Hall	Present	Present	Present	Present	Present	Present	Present	Present
2	Fitness Center	Present	Present	Present	Present	Present	Present	Present	Present
4	DLS & Personnel Security	Present	Present	Present	Present	Present	Present	Present	Present
5	Credit Union	Present	Present	Present	Present	Present	Present	Present	Present
7	Material Management	Present	Present	Present	Present	Present	Present	Present	Present
12	Human Resources	Present	Present	Present	Present	Present	Present	Present	Present
18	Former Store House	Present	Present	Present	Present	Present	Present	Present	Present
20	Former New Stable Area	Present	Present	Present	Present	Present	Present	Present	Present
22	College & Training Center	Present	Present	Present	Present	Present	Present	Present	Present
25	Public Affairs	Present	Present	Present	Present	Present	Present	Present	Present
36	Main Building	Present	Present	Present	Present	Present	Present	Present	Present
37	Material Management Building	Present	Present	Present	Present	Present	Present	Present	Present
39	Guardhouse	No feature discerned	Possibe buildiing present	Present	Present	Present	Present	Present	Present
AOC-1	Dark-Toned Mounded Material	Open area	Parking lot	Dark-toned mounded material	Open area	Parking lot	Parking lot	Parking lot	Parking lot
AOC-2	Storage Area	Covered storage/supplies	Covered storage/supplies	Covered storage/supplies	Covered storage/supplies	Covered storage/supplies	Covered storage/supplies	Covered storage/supplies	Covered storage/supplies
AOC-3	Mounded Material	No feature discerned	No feature discerned	No feature discerned	No feature discerned	Dark-toned mounded material, ground stain	Open storage srea	Open storage srea	Open storage area
AOC-4	Vertical Tank	One vertical tank	Two vertical tanks	One vertical tank	Vertical tank removed, excavation	Debris pile	Scrap metal debris pile	Open area	Open area
AOC-5	Vertical Tanks (5)	No feature discerned	Horizontal tanks (5)	Horizontal tanks (5)	Open storage area	Parking lot	Parking lot	Parking lot	Parking lot
AOC-6	Open Storage Area	No feature discerned	Present	Present	Present	Present	Present	Present	Present
AOC-7	Barge Loading	Mooring platform	Barge loading pier constructed	Present	Present	Present	Present	Present	Present
A	Site Building	Present	Present	Present	Present	Building removed, parking lot	Parking lot	Parking lot	Parking lot
B	Site Building	Present	Present	Present	Building removed, parking lot	Parking lot	Parking lot	Parking lot	Parking lot
C	Site Building	Present	Present	Present	Present	Present	Present	Parking lot	Parking lot
D	Site Building	Present	Present	Present	Present	Building removed, parking lot	Parking lot	Parking lot	Parking lot
E	Site Building	Present	Present	Present	Building removed, parking lot	Parking lot	Parking lot	Parking lot	Parking lot
F	Site Building	Present	Present	Present	Present	Building removed, parking lot	Parking lot	Parking lot	Parking lot
G	Site Building	Pavement	Pavement	Pavement	Building constructed	Present	Present	Present	Present
H	Site Building	Present	Present	Present	Building removed, parking lot	Parking lot	Parking lot	Parking lot	Parking lot
I	Site Building	Possible shed	Probable guardhouse	Guardhouse	Guardhouse	Guardhouse	Guardhouse	Guardhouse	Guardhouse
J	Site Building	Grassy area	Pavement	Parking lot	Parking lot	Parking lot	Parking lot	Building constructed	Present
R/R	Railroad	Present	Present	Present	Present	Present	Present	Present	Present
K	River Terminal Wharf Building	Present	Present	Present	Present	Present	Present	Present (roof changed)	Present
L	River Terminal Wharf Building	No feature discerned	Present	Present	Present	Present	Present	Building removed	Large building constructed
M	River Terminal Wharf Building	No feature discerned	Present	Present	Building removed	Open storage area	Large building constructed	Present	Present
N	River Terminal Wharf Building	No feature discerned	Open storage area	Building constructed	Present	Present	Present	Present	Present
O	River Terminal Wharf Building	No feature discerned	Present	Present	Present (building remodeled)	Present	Present	Present	Building removed, parking lot
P	River Terminal Wharf Building	Probable building	Present	Present	Building removed	Parking lot	Parking lot	Parking lot	Parking lot
Q	River Terminal Wharf Building	Probable building	Present	Present	Present	Present	Present	Present	Present
R	River Terminal Wharf Building	Probable building	Present	Present	Present	Present	Present	Present	Present
S	River Terminal Wharf Building	Probable open storage area	Probable open storage area	Probable open storage area	Present	Present	Present	Present	Present
T	River Terminal Wharf Building	Present	Present	Present	Present	Building removed, driveway	Driveway	Walkway	Walkway
U	River Terminal Wharf Building	Present	Present	Building removed, parking lot	Parking lot	Parking lot	Parking lot	Parking lot	Parking lot
V	River Terminal Wharf Building	Open area	Open area	Open storage area	Open storage area	Parking lot	Parking lot	Building constructed	Present
W	Excavation	No feature discerned	No feature discerned	No feature discerned	Excavation activity	River terminal building	River terminal building	River terminal building	River terminal building
X	Railroad spur	No feature discerned	Present	Present	Present	Present	Present	Present	No feature discerned
Y	Fill Area	No feature discerned	No feature discerned	No feature discerned	Present	No feature discerned	No feature discerned	No feature discerned	No feature discerned
Z	Levee	River bank (not annotated)	River bank (not annotated)	River bank (not annotated)	Levee construction	Present	Present	Present	Present

Figure 3. St. Louis (EX) Arsenal site, September 19, 1937. Approximate scale 1:3,910.

Figure 4. St. Louis (EX) Arsenal site, July 17, 1941. Approximate scale 1:3,910.

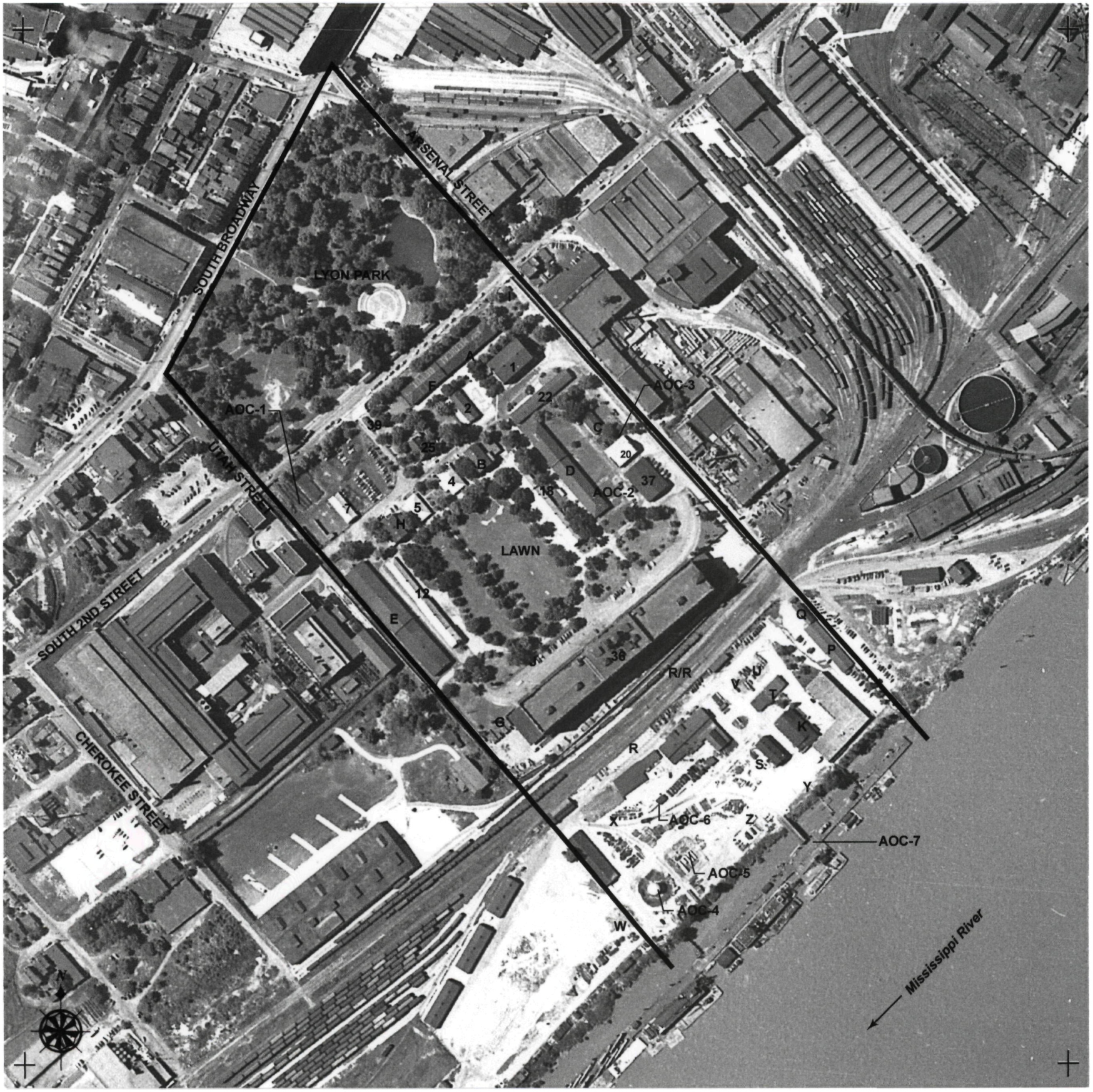

Figure 5. St. Louis (EX) Arsenal site, June 27, 1950. Approximate scale 1:3,810.

Figure 6. St. Louis (EX) Arsenal site, March 3, 1968. Approximate scale 1:3,810.

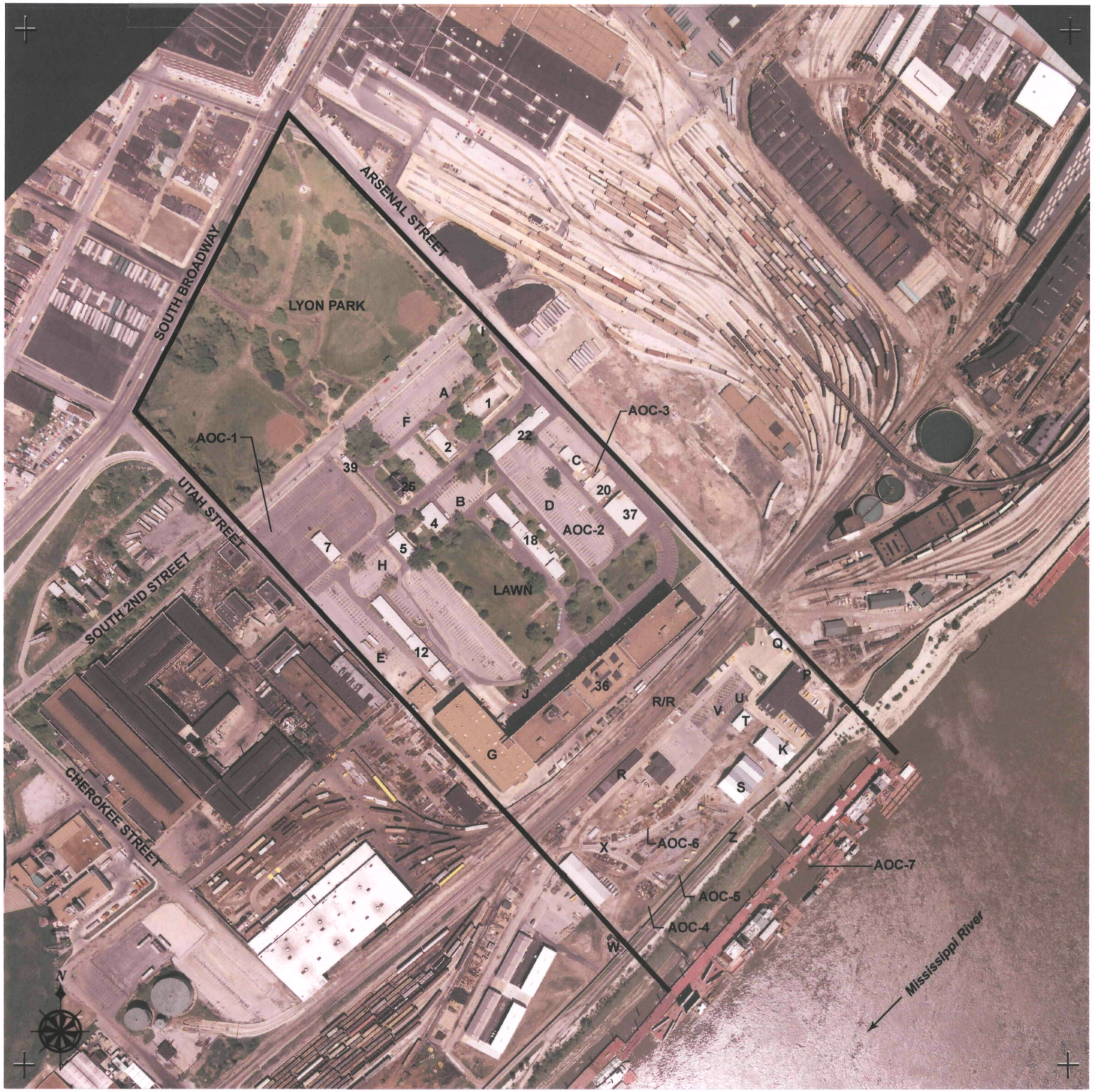

Figure 7. St. Louis (EX) Arsenal site, April 24, 1977. Approximate scale 1:3,870.

Figure 8. St. Louis (EX) Arsenal site, October 16, 1982. Approximate scale 1:3,695.

Figure 9. St. Louis (EX) Arsenal site, December 21, 1993. Approximate scale 1:3,750.

Figure 10. St. Louis (EX) Arsenal site, March 10, 2004. Approximate scale 1:3,810.

GLOSSARY

Building - A relatively permanent, essentially boxlike construction having a roof.

Dark-, Medium-, or Light-Toned - Tones of features in question are compared with the darkest and lightest tones of gray (if using B&W photography) on the print.

Debris - The remains of anything that can be identified as being broken down, destroyed, demolished, or dismantled.

Excavation Area - An area where earth or other material is being removed in order to alter the ground level (e.g., building construction).

Fill Area - An area where material is being deposited to fill a depression; or area where materials have been added, altering the elevation of the ground surface.

Mounded Material - Piles of raw or waste materials on or in the vicinity of the site.

Open Storage Area - An area of open-air (outdoor) storage of containerized, raw or waste materials, within industrial or manufacturing sites.

Stain - A residue or discoloration resulting from a spill, discharge, or removed/dispersed materials.

Tanks - Vertical tanks, horizontal tanks, pressure tanks, tank farms, and solid waste management units. A large receptacle, container, or structure for holding liquid or gas.

REFERENCES

MAPS

Source[a]	Figure	Name	Scale	Date
USGS	1	United States	1:2,500,000	1972
USGS	2	Cahokia, IL-MO	1:24,000	1993

COLLATERAL INFORMATION

EPA. 2004. Collateral data and site map supplied by EPA Region 7 as attachment to Remote Sensing Services Request Form.

LMS (Lockheed Martin Services). 2004. Master Quality Assurance Project Plan. Prepared for EPA Environmental Sciences Division. Contract 68-D-00-267. Las Vegas, Nevada.

Techlaw. 2004. U.S. Environmental Protection Agency Regional Oversight Contract, Draft Federal Facility Site Inspection Review, Defense Mapping Agency Aerospace Center, CERCLIS ID# MO4570090023, January 22, 2004.

AERIAL PHOTOGRAPHS

Photo source[a]	Figure[b]	Date of acquisition	Original scale	Film type[c]	Mission I.D.	Source frame #	EPIC ID #
KVT	3	09-19-37	1:20,000	B&W	7IL	1917	105378
KVT	4	07-17-41	1:20,000	B&W	ON31600	55	105374
KVT	5	06-27-50	1:20,000	B&W	SKIF	90	63994
KVT	-	09-07-53	1:20,000	B&W	ON39107	180	105380
USGS	6	03-03-68	1:24,000	B&W	UNK	248	62467
EPA	7	04-24-77	1:6,000	CC	7720	77-165:211	-
EPA	8	10-16-82	1:6,000	CC	82023	82-197:595	-
EPA	9	12-21-93	1:24,000	CC	94618	93_040:47	-
SURDEX	10	03-10-04	1:35,000	B&W	UNK	123	105383

[a]EPA U.S. Environmental Protection Agency, Environmental Sciences Division, Las Vegas, Nevada
KVT King Visual Technology, Hyattsville, Maryland
SURDEX Surdex Corp., Chesterfield, Missouri
USGS U.S. Department of Interior, U.S. Geological Survey, Washington, D.C.

[b]Photographs listed with no figure number were analyzed, but not placed in this report.

[c]B&W Black-and-white
CC Conventional Color